**Title:** DEVICES FOR TRANSPORTING REELS OF MATERIAL

Specification

Devices for Transporting Reels of Material

The invention relates to devices for transporting reels of material according to the preamble to claim 1, 2, 3 or 4.

On web-processing machines, such as web-fed rotary printing presses, so-called reel changers are provided that serve to supply material, for example a web of printing material, to the machine. During a reel change, the wound off reel of material is removed from the reel changer and is replaced by a new reel of material. Various transport systems for transporting the new reels of material to the reel changer or for transporting the wound off reels of material away from the reel changer are known from the prior art.

In EP 0 925 246 B1 a complex system for transporting reels of material to and from the reel changer of a printing machine is described. In this, the reels of material are stored on their circumferential surfaces on so-called first transport carriages. The actual conveyance of the reels of material is then accomplished by loading the first transport carriages onto so-called second transport carriages. This means, in other words, that the first transport carriages are loaded, piggyback, onto the second transport carriages. In the system described in EP 0 925 246 B1, a total of four different sections for the second transport carriages are provided, wherein none of the second transport carriages can move outside of the transport section to which they are assigned. Directly in front of the reel changer, a section for a second transport carriage is provided, which carriage can be moved into an upload position and an unload position for the reel changer. By loading a first transport carriage, on which a new reel of material is deposited, onto a second transport carriage in this section at the reel changer, the new reel of material can be brought into the position that is necessary for uploading. Accordingly, by loading a wound-off reel of material onto a first transport carriage that has been moved to the unload position by means of the second transport carriage, the wound-off reel of material can be transported away.

JP 63-074852 A shows a railless transport carriage with a device for lifting reels of material. This transport carriage removes the reels of material from intermediate storage stations and transports the reels of material to a reel changer.

The object of the invention is to provide devices for transporting reels of material.

The object is attained according to the invention with the characterizing features of claim 1, 2, 3 or 4.

One benefit of the device of the invention consists especially in that the second transport carriage can also be moved along at least one transport route into a storage area in which new and/or completely or partially wound-off material reels can be stored in a plurality of storage spaces. In this manner, the existing second transport carriage for uploading the reels of material into the reel changer can also be used to transport the reels of material out of a storage area or into a storage area. Furthermore, it is conceivable for the second transport carriage to either convey new reels of material directly to the reel changer, or for the new reels of material to be first placed in the storage area and stored there intermediately until retrieval for later use. Above all, with the new device an awkward transfer among the individual sections for the different second transport carriages can be avoided.

According to one preferred embodiment, the storage area is designed as an intermediate storage area, especially in the manner of a daily storage area. In other words the storage area, which can be approached with the second transport carriage, serves not for storage of the entire inventory of reels of material, rather it is intended only for the intermediate storage of a specific, preferably smaller number of reels of material near the reel changer. In addition, the reels of material in the intermediate storage area are intended to be already unpacked and prepared for the reel change with splices. If the storage area is designed in the manner of a daily storage area, then roughly the number of reels of material that are required for daily use by the web-processing machine are placed in intermediate storage in the daily storage area.

In principle, it is conceivable for the reels of material to be unloaded again from the first transport carriage in the storage spaces of the storage area. However this can cause damage to the reels of material. The storage spaces in the storage area should therefore preferably be designed such that at least one first transport carriage can be placed in each storage space. Unloaded first transport carriages can also be placed in the different storage spaces, thereby providing a storage space for the first transport carriages that is relatively close to the machine.

The arrangement of the transport carriages in the various storage spaces of the storage area should preferably be freely optional, so that as a result ultimately any first transport carriage can be placed in any storage space in the storage area. In this manner a very high degree of flexibility and variability in the use of the storage area is realized.

The functional scope for utilization of the second transport carriage can be substantially increased in that the first transport carriage can also be moved along a transport route into an unpacking station for unpacking the reels of material. In this manner, once new reels of material have been unpacked in the unpacking station, they can be retrieved and transported to subsequent processing stations.

Further, it is especially advantageous if the first transport carriage can also be moved along a transport route to a splice preparation station. In this manner, once the splices have been applied to the leading edge of the web, the unpacked reels of material can be retrieved from the splice preparation station and transferred to subsequent processing stations. In addition, system configurations are also conceivable in which especially the splice preparation station also serves simultaneously as the unpacking station, so that the first transport carriage retrieves the reels of material from this combined station and transfers them to subsequent processing stations.

In the interest of an efficient transport of material, the unpacking station and/or the splice preparation station should be positioned in front of the storage spaces in the storage area, relative to the direction of transport of the reels of material. In this manner, in the transport of unpacked reels of material, or reels of material that have been prepared with splices, in the storage area, only very short transport routes are necessary. The unpacked or splice-prepared reels of material can then be retrieved from the storage area at a later time via the second transport carriage, and transferred to the reel changer.

In order to necessitate the least possible amount of directional change in the transport of the reels of material to the reel changer, it is particularly advantageous for the transport route in the storage area, on which the second transport carriage can be moved, to extend as a virtual extension of the direction of web travel in the web-processing machine.

As an alternative or in addition to this, the transport route in the storage area can also extend parallel to the extension of the direction of web travel in the web-processing machine, whereby especially very compact system configurations can be realized.

The manner in which the storage spaces are configured in the storage area is essentially optional. According to one preferred embodiment, branch lines, via which the storage spaces can be approached, extend off of the transport route in the storage area. In this manner it is conceivable, for example, for the second transport carriage to transport the piggyback-loaded

first transport carriages up to the branch line, where the first transport carriage can deposit the reel of material in the proper storage space by moving into the branch line. In this manner, the first transport carriage remains together with the corresponding reel of material in the storage space, until the reel of material is again retrieved from the storage space and further transported by the first transport carriage being loaded onto the second transport carriage.

Depending upon the configuration of the system, storage spaces can be provided on both sides of the transport route or on only one side of the transport route.

For the functioning of the device, the most precise possible positioning of the second transport carriage is of great importance. For example if, during unloading of a first transport carriage, the second transport carriage is positioned in front of a branch line, precise positioning is essential, as otherwise the first transport carriage cannot be moved into the branch line. Therefore, along at least certain sections of the transport route a position-sensing system should be provided, with which the second transport carriage can be precisely positioned.

Furthermore, for reasons of occupational safety, an area security system should be provided, which will secure the boundaries of the storage area against unauthorized entry.

In a particularly simple manner, the area security system can be implemented by erecting a perimeter fence around the storage area. By using the area security system on the reel changer as a simultaneous area security system for the storage area, the expense required for implementing the area security system can be reduced.

To allow the transport of reels of material into or out of the storage area, a transfer channel can be provided in the area security system. In the transfer channel area, the area security system should preferably operate without contact, for example by the use of photoelectric sensors or ultrasound sensors. By positioning the sensors at various levels, complex scanning patterns can be implemented, so that, for example, reels of material can pass without difficulty into the transfer channel, whereas an unauthorized exceeding of the sensor signals will trigger an alarm.

In order to prevent reels of material from being held too long in the storage area, the storage area should be operated according to the FIFO principle (first in, first out). This means that the reels of material that are placed in the storage area first are also transferred to the reel changer first. Exemplary embodiments of the invention are illustrated in the set of drawings and will be described in greater detail in what follows.

The drawings show:

Fig. 1 a first variant of a printing system with a device for transporting reels of material;

Fig. 2 a second variant of a printing system with a device for transporting reels of material;

Fig. 3 a third variant of a printing system with a device for transporting reels of material;

Fig. 4 a fourth variant of a printing system with a device for transporting reels of material;

Fig. 5 the reel changer for the printing systems shown in Fig. 1 through Fig. 4, in cross-section;

Fig. 6 the device for transporting reels of material, with a transport carriage in various positions;

Fig. 7 a variant of the transport carriage, designed to hold two reels of material;

Fig. 8 a further variant of a printing system with two daily storage areas.

In Fig. 1, a printing system with a device for transporting reels of material 01 is shown in a schematic plan view. From a main storage area 02, the packaged reels of material 01 are transported via a suitable mode of transport, such as a clamping stacker truck, to the area of the unpacking station 03, where they are deposited on a reel receiver 04. In the unpacking station 03, the reels of material 01 are manually rolled onto a first transport carriage 27. For this purpose, the first transport carriage 27 has a suitable trough on its upper surface, which is designed to hold the reels of material 01 securely in place. By pressing a button, the reel of material 01 is transported to the center of the unpacking station 03, centered, and then manually unpacked. After it is unpacked, the operators also apply the necessary splices 15 to the leading edge of the web of the reel of material 01, so that the unpacking station 03 serves at the same time as a splice preparation station 03.

The web-processing machine 06 is designed in the manner of a web-fed rotary printing press 06, in which a web of printing material passes through four printing couples 07 in sequence. In this, the web of printing material can, for example, be printed in four colors and on both sides, after which it is dried in a dryer 08. To supply the printing couples 07 with the web of printing material, a reel changer 09, in which two reels of material 01 can be mounted, is positioned in front of the web-processing machine 06. With the reel changer 09, a floating reel change can be implemented without machine down time.

The web-fed rotary printing press is especially designed as a gravure printing machine or an offset printing machine (for example a commercial printing machine). Preferably, for example, the floor of the shop, the storage area and/or the reel changer and/or the printing couples are arranged, for example, one behind another in a single plane 20 (relative to the direction of web travel).

In the immediate vicinity of the reel changer 09, a storage area 11 is provided, which is designed as an intermediate storage area for storage of the reels of material 01 required for one day. On each side of a transport route 12, eight storage spaces 13 are provided in the storage area 11. A first transport carriage 27 with a reel of material 01 deposited thereon can be positioned in each storage space 13.

Once the splices 15 have been prepared on the reel of material 01, a second transport carriage 27 takes over the reel of material 01 at the unpacking station, with the reel of material 01 in its raised position, and travels with it to the point of transfer onto the transport carriage 32. There, the transport carriage 27 is loaded piggyback onto the transport carriage 32. By moving the second transport carriage 32, the splice-prepared reel of material 01 can optionally be conveyed via a transport route 14 directly to the reel changer 09 or via the transport route 12 to the storage area 11. The decision as to whether the reel of material 01 will be transferred from the unpacking station 03 directly to the reel changer 09 or into the storage area 11 is made based upon the control by a material supply system.

If the splice-prepared reel of material 01 is to be conveyed to the storage area 11, then the second transport carriage 32, with the first transport carriage 27 loaded piggyback onto it, and the reel of material 01 loaded onto that, travels via the transport route 12 into the storage area 11 until it reaches an empty storage space 13. In front of the empty storage space 13, the second transport carriage 32 is then positioned such that the first transport carriage 27 can be pushed into the branch line 16 of the storage space 13. The second transport carriage 32 then leaves the storage area 11 again via the transport route 12, wherein it can optionally also carry another first transport carriage 27 out of the storage area 11. When a new reel of material 01 is required on the reel changer 09, either a reel of material 01 that has just been unpacked is conveyed from the unpacking station 03 via the transport route 14 to the reel changer 09, or a reel of material 01 that is already provided with splices 15 is conveyed from the storage area 11 to the reel changer 09.

Because the transport route 12 extends through the storage area 11 in a virtual extension of the direction of web travel through the web-processing machine 06, in the transport of a reel of material 01 out of the storage area 11 to the reel changer 09, no change in direction of the second transport carriage 32 is necessary.

The storage area 11 is protected against unauthorized entry. On three sides of the storage area 11 this security is provided by a secured area, especially by a perimeter fence. On the side of the storage area 11 that faces the reel changer 09, a transfer channel 18 is provided in the area security system 37 for the reel changer 09. In the area of the transfer channel 18, the area

security system 37 is realized via photoelectric beams or sensors, for example laser sensors, which function without contact.

The storage or retrieval of the reels of material 01 in the storage area 11 is operated according to the FIFO principle, in order to prevent the reels of material 01 from being intermediately stored too long in the storage area 11, which would cause the splices 15 to become unusable.

In Fig. 2, a second system variant is schematically shown. This variant differs from the variant shown in Fig. 1 in that between the unpacking station 03 and the reel changer 09 or the storage area 11 an additional transport route 19 is provided, via which the second transport carriage 32 transports the piggyback-loaded first transport carriage 27 and the reel of material 01 deposited thereon to the reel changer 09 or to the storage area 11. Two rotating platforms 21 are included in the transport route 19, to permit the change of direction of the first transport carriage 27 between the unpacking station 03 and the storage area 11 or the reel changer 09.

In the system variant shown in Fig. 3, a storage area 22 that serves as an intermediate storage area is provided, in which a transport route 23 extends through the storage area 22, thereby running perpendicular to the direction of web travel in the web-processing machine 06. In the transport of a reel of material 01 from the unpacking station 03 to the reel changer 09, the first transport carriage 27 passes through the entire storage area 22 along the transport route 23. Based upon requirements of the control system of the material supply system, a splice-prepared reel of material 01 in the unpacking station 03 is either first placed in intermediate storage in the storage area 22 or is conveyed directly to the reel changer 09. Furthermore, a reel of material 01 that has already been prepared with splices 15 can be retrieved as needed from the storage area 22 and conveyed to the reel changer 09. In addition, the storage spaces 13 in the storage area 22 are located on both sides of the transport route 12, and thus parallel to the web-processing machine 06, resulting in a highly compact system configuration.

In Fig. 4, a fourth variation is illustrated, which corresponds largely to the system shown in Fig. 3. In contrast to the system shown in Fig. 3, however, in the storage area 24 storage spaces 13 are provided on only the left side of the transport route 12, so that overall an even more compact system configuration is enabled. The system is controlled via a control center 26.

In Fig. 5, the reel changer 09 is shown in cross-section. First transport carriages 27 are used to transport new and wound-off reels of material 01 to and from it. Known transport carriages 27 of this type are, for example, rail-guided. The transport carriage 27 has four runners 28 that travel on rails. To actuate the transport carriages 27, for example, a drag conveyor that extends underneath the floor can be provided, which is designed, for example, as a continuous chain. The

transport carriage 27 is attached to this chain at least part of the time. A trough-shaped tray 29 designed to accommodate the reels of material 01 is attached to a support frame of the transport carriage 27. Said tray 29, which serves as a receptacle, protrudes from the floor 31 of the storage room, whereas the first transport carriage 27 proceeds recessed beneath the floor 31 of the storage room.

In each of the branch lines 16, segments of track are provided, in which the runners 28 of the first transport carriages 27 can run. In addition, in each storage space 13 a separate chain drive is provided. Preferably, at least the majority of the storage spaces 13 are equipped with a separate chain drive.

The storage spaces 13 or branch lines 16 each hold a reel of material 01 or a transport carriage 27. However, they can also accommodate precisely 2, or more reels of material 01.

Second transport carriages 32 are used to convey the first transport carriages 27 along the transport routes 12 and 14. The support frame of each second transport carriage 32 has a short segment of track 33, in which the runners 28 of a first transport carriage 27 can run. The second transport carriages 32 are also arranged underneath the floor and are provided with four runners 34 that are guided on rails. Chain drives can also be used to convey the second transport carriages 32.

In an alternative embodiment, the second transport carriage 32 can also have two segments of track 33; 33'. In this, a distance a between the two segments of track 33; 33' is greater than a maximum diameter $D_{max}$ of the reels of material 01 to be transported. Preferably, the distance a between the two segments of track 33; 33' of the transport carriage 32 is equal to the distance a between the segments of track 33; 33' of the branch lines 16 of the storage spaces 13.

At least one of the transport carriages 27 can carry an adapter designed to accommodate partially used reels.

The longitudinal direction and the direction of web travel in the web-processing machine extend in essentially the same direction.

No rotating platforms for the transport carriages 27 are arranged between the storage spaces 13 and the reel changer 09. Also, no rotating platforms are arranged between the storage spaces 13 and the splice preparation station 03 for the transport carriages 27.

At least one printing couple 07, the reel changer 09 and the storage spaces 13 are arranged nearly in a common plane 20. An arrangement of all printing couples 07 in a single common plane is advantageous. The processing machine further has a single reel changer. The transport route of the second transport carriage 32 and the longitudinal axis 10 of a dryer 08 of the processing machine are arranged such that they lie in alignment, or they are arranged in a parallel offset arrangement.

In this, the lower edge of the relevant side frame serves as the point of reference for the printing couples 07 and the reel changer 09, and the mount of the transport carriages 27 serves as the point of reference for the storage spaces 13. The common plane 20 in this is the floor of the building.

The device for transporting reels of material operates on the basis of the specific reel data recorded in the transport or preparation process, such as, for example, the bar code and/or the reel width and/or the reel status and/or the weights (gross weight, net weight 1, net weight 2) and/or the splice time and/or the run length, etc. This encompasses, for example, the data recording and/or data management and/or data allocation in the overall process, i.e. from the receipt of the goods up to disposal of the sheathing.

Thus the data are maintained and managed in the relevant process steps. In connection with this, for example, the evaluation and storage of these data for the purpose of further exploitation can be implemented via a suitable management/support system. It is further possible to use the reel data that are recorded via the reel changer/changers during and following the winding-off process for entry into the specific record for the reel and its allocation.

Furthermore, the device is capable of handling partial reels or reels returned from the production process, and managing them accordingly in the transport, preparation and data management processes. This includes all processes associated therewith. One component of this is the processes associated with the transport of partial reels, for example via adapters. The management of the adapters (with and without reels) and all processes necessary to this can also be integrated, for example.

A further characterizing feature of a device of this type involves the use of multiple reel carriages per storage area position, and all the processes necessary to this.

One variant also involves the use of a transfer table with multiple rail lines, which enables further optimizations of said device.

Another possible characterizing feature is the transport of the sleeve container and its data content to specific, for example freely selectable, positions in the storage area, or to other possible positions in said device. Further data transfers to the management system or to other evaluation units in the machine or production preparation system can also be included in this.

List of Reference Symbols

01 Reel of material
02 Main storage area
03 Unpacking station, splice preparation station
04 Reel receiver
05 -
06 Web-processing machine, processing machine, web-fed rotary printing system, web-fed rotary printing press
07 Printing couple, web-processing station
08 Dryer
09 Reel changer
10 Longitudinal axis
11 Storage area, daily storage area
11' Track segment
12 Transport route
13 Storage space
14 Transport route
15 Splices
16 Branch line, branch path
17 Secured area
18 Transfer channel
19 Transport route
20 Plane
21 Rotating platform
22 Storage area, daily storage area
23 Transport route
24 Storage area, daily storage area
25 -
26 Control center
27 Transport carriage, first
28 Runner
29 Tray
30 -
31 Floor
32 Transport carriage, second
33 Track segment
33' Track segment

34 Runner

35 -

36 Transfer point

37 Area security, secured area

a Distance between the track segments or the branch lines

$D_{max}$ Maximum diameter of a reel of material to be transported